REMARKS

Claims 1-18 are pending herein. Claims 1-4, 6-8, 10 and 13 have been rewritten for clarification purposes only. Attached hereto as pages 9-11, pursuant to Rule 1.121(c)(1)(ii), is a marked-up version of the amended claims.

1. Claims 1-18 were rejected under §103(a) over Newkirk et al. This rejection is respectfully traversed.

The present invention is directed to a method of forming intermetallic compound-based composite materials. Independent claims 1 and 13 recite a process for producing an intermetallic composite material in which a metal and a reinforcing material are mixed in powder form. The mixed powder is then placed into a reaction vessel and impregnated with an aluminum melt to obtain an aluminide intermetallic composite via a spontaneous combustion reaction (i.e., self-propagating high temperature synthesis (SHS)). Reaction heat generated between the molten aluminum and the metal in the mixed powder drives the reaction to completion and results in complete infiltration of the Al into the composite through capillary action. That is, the spontaneous reaction between the metal powder in the reaction vessel and the molten Al causes the molten Al to be drawn into the composite automatically. Accordingly, it is not necessary to supply a specifically controlled reaction atmosphere (as in the prior art) to achieve infiltration.[1] The prior art, discussed below, does not disclose or suggest the use of an exothermic reaction to produce an intermetallic composite material.

In addition to the above, claims 1 and 13 each recite that the ratio of aluminum to intermetallic composite material, remaining after the spontaneous combustion reaction, is within a range from 0:10 to 3:7. Applicant discovered that certain benefits arise out of

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[1] Chemical formulas 1-3 discussed in paragraphs [0032] and [0033] of the present specification illustrate this SHS or exothermic reaction process, for example.

controlling the amount of residual aluminum in this manner, which include: a composite material having sufficient mechanical strength near the melting point of aluminum; a composite material having thermal resistance without showing a corresponding reduction in mechanical strength; and a composite material having increased fracture resistance characteristics due to a ductile phase (see paragraph [0037] of the present specification). The prior art, discussed below, does not disclose or suggest controlling the ratio of aluminum remaining in the reaction product with respect to the reaction product.

Newkirk discloses a method of modifying the properties of a metal matrix composite body. Modification of Newkirk's metal matrix can occur during or subsequent to the step of forming the metal matrix (column 15, lines 42-47). If the modification step is performed during formation of the metal matrix, a second metal (e.g., nickel, copper, magnesium, etc.) is alloyed with the matrix metal (e.g., aluminum; column 16, line 50 -- column 17, line 8).

Fig. 1 of Newkirk (discussed in Example 1) illustrates the process of modifying the matrix metal during the spontaneous infiltration (not a spontaneous combustion reaction, as discussed below) of the molten matrix metal into a preform of filler material. An ingot of matrix metal 18 is positioned above a particulate mixture 19 and fired sediment cast preform 13 placed in a graphite foil box 12. The matrix metal 18 includes 15 wt.% of Si, 5 wt.% of Mg and the balance of Al, which equates to 80 wt.% of Al (column 32, lines 10-14). The contents of graphite foil box 12 are heated in a vacuum chamber for a certain amount of time while maintaining a specified nitrogen flow rate (column 32, lines 20-30).[2]

Newkirk's method of providing an infiltrating atmosphere which facilitates modifying the properties of the metal matrix while spontaneously infiltrating the metal matrix into a filler material or preform 13 does not disclose or suggest the spontaneous combustion

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[2] There are no examples in Newkirk where the modification of the metal matrix during formation of the metal matrix did not include flowing nitrogen gas at a specified flow rate in a furnace chamber maintained within a specified temperature range.

reaction recited in pending claims 1 and 13. Newkirk's method requires the external application of heat to the reactants in the presence of nitrogen, which functions as the infiltrating atmosphere (see Examples and column 10, lines 56-62). The infiltrating atmosphere provides an atmosphere in which a gas phase reaction between magnesium (which has been sprinkled over the preform) and nitrogen occurs on the surface of preform 13, which improves the wettability of the preform while the molten aluminum is spontaneously infiltrated into the pores of the preform due to capillary pressure.[3] As such, the infiltrating atmosphere facilitates the "spontaneous infiltration" of the aluminum. That is, without the N_2 atmosphere, infiltration would not succeed (Newkirk, col. 25, lines 11-15). This process does not encompass the formation of an aluminide intermetallic compound through the heat generated from the reactants during a *spontaneous combustion reaction*, as claimed in claims 1 and 13. Again, the spontaneous combustion reaction occurring in the claimed process assures infiltration of molten Al by capillary action; no infiltrating atmosphere is needed.

Moreover, Newkirk does not disclose or suggest, or recognize the benefits associated therewith for that matter, of controlling the amount of residual aluminum remaining in the formed product (i.e., post infiltration reaction). As explained above, Newkirk discloses that if the modification of the metal matrix is performed simultaneously with the formation of the metal matrix, the second metal (e.g., nickel, copper, magnesium, etc.) is ***alloyed*** with the matrix metal.[4] The starting material of the matrix metal is an aluminum-rich composition, which includes, for example, 15 wt.% of Si, 5 wt.% of Mg and the balance of aluminum,

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[3] Newkirk's process requires preheating the reaction furnace for a long period of time to homogenize the distribution of Mg vapor and nitrogen gas to induce infiltration of the molten aluminum. As such, Newkirk does not disclose or suggest a modification step which includes the use of an exothermic reaction (i.e., spontaneous combustion reaction) between the molten aluminum and the metal in preform 13 to cause infiltration.

[4] See Tables I and IV, for example, which clearly illustrate that the matrix metal is an aluminum alloy metal.

which equates to 80 wt.% of Al (column 32, lines 10-14). Accordingly, Newkirk's post infiltration reaction product has a composition which includes an elevated amount of aluminum because only a part of the aluminum is converted into an intermetallic compound due to the presence of other metals (e.g., nickel, copper, magnesium, etc.) in the alloy metal starting material. In contrast to Newkirk, pending claims 1 and 13 recite controlling the ratio of residual aluminum to intermetallic composite to achieve the beneficial results discussed on pages 5 and 6, *supra*. Applicant respectfully submits that, based on disclosure in Newkirk, skilled artisans would not have recognized the importance of or have been motivated to attempt to control the ratio of remaining Al to intermetallic composite material to be within any range, let alone to be within a range from 0:10 to 3:7, as is recited in claims 1 and 13.

In view of all of the foregoing, reconsideration and withdrawal of the rejection of claims 1-18 under §103(a) over Newkirk et al. are respectfully requested.

If the Examiner believes that contact with Applicant's attorney would be advantageous toward the disposition of this case, the Examiner is herein requested to call Applicant's attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

Respectfully submitted,

October 24, 2002
Date

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1. (Amended) A process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound, ~~which comprises~~comprising the steps of: mixing a metal powder with a reinforcing material to obtain a mixed powder, ~~fulfilling~~filling ~~thus obtained~~the mixed powder into a vessel, placing Al on an upper side of the mixed powder ~~fulfilled~~filled into the vessel, and impregnating the mixed powder with an Al melt, ~~to give rise to~~wherein a spontaneous combustion reaction between the metal powder and the Al melt ~~to~~ converts the Al melt into an aluminide intermetallic compound, ~~wherein~~and the Al melt and the metal powder are used respectively in such amounts that a mass ratio of a remaining Al after the spontaneous combustion reaction to the intermetallic compound-based composite material is within a range from 0:10 to 3:7.

2. (Amended) A process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound according to claim 1, wherein Ti powder ~~is used as~~comprises said metal powder, and Ti powder is mixed with Al in a relative mass ratio of 1:0.34 to 1:0.57, ~~taking~~with the mass of Al ~~as~~being 1.0.

3. (Amended) A process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound according to claim 1, wherein Ni powder ~~is used as~~comprises said metal powder, and Ni powder is mixed with Al in a relative mass ratio of 1:0.47 to 1:0.72, ~~taking~~with the mass of Al ~~as~~being 1.0.

VERSION WITH MARKINGS TO SHOW CHANGES MADE
Amended claims

4. (Amended) A process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound according to claim 1, wherein Nb powder ~~is used as~~comprises said metal powder, and Nb powder is mixed with Al in a relative mass ratio of 1:0.75 to 1:1.13, ~~taking~~with the mass of Al ~~as~~being 1.0.

6. (Amended) A process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound according to claim 5, wherein Ti powder ~~as a~~comprises said metal powder and is mixed with Al in a relative mass ratio of 1:0.57 to 1:6.14, ~~taking~~with the mass of Al ~~as~~being 1.0.

7. (Amended) A process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound according to claim 5, wherein Ni powder ~~as a~~comprises said metal powder and is mixed with Al in a relative mass ratio of 1:0.72 to 1:7.20, ~~taking~~with the mass of Al ~~as~~being 1.0.

8. (Amended) A process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound according to claim 5, wherein Nb powder ~~as a~~comprises said metal powder and is mixed with Al in a relative mass ratio of 1:1.13 to 1:12.16, ~~taking~~with the mass of Al ~~as~~being 1.0.

10. (Amended) A process for producing an intermetallic compound-based composite material according to claim 1, wherein the reinforcing material is an inorganic

material having a shape selected from the group consisting of fibrous shapes, particulate shapes and whisker shapes.

13. (Amended) A process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound,~~: said process~~ comprising the steps of:~~;~~ mixing a metal powder and an oxide powder reducible by Al with a reinforcing material to obtain a mixed powder, ~~fulfilling~~filling ~~thus obtained~~the mixed powder into a vessel, placing Al on an upper side of the mixed powder ~~fulfilled~~filled into the vessel, and impregnating the mixed powder with an Al melt, ~~to give rise to~~wherein a spontaneous combustion reaction between the metal powder and the Al melt ~~to~~ converts the Al melt into an aluminide intermetallic compound, ~~wherein~~and the Al, the metal powder and the oxide powder are used respectively in such amounts that a mass ratio of a remaining Al after the spontaneous combustion reaction to the intermetallic compound-based composite material is within a range from 0:10 to 3:7.

Paragraph [0003] has been amended as follows:

[0003] Among composite materials, metal-based composite materials or intermetallic compound-based composite materials are composite materials obtained by reinforcing a matrix, i.e. a metal (e.g. Al, Ti, Ni or Nb) or an intermetallic compound (e.g. TiAl, Ti_3Al, Al_3Ti, NiAl, Ni_3Al, Ni_2Al_3, Al_3Ni, Nb_3Al, Nb_2Al or Al_3Nb), with an inorganic material (e.g. a ceramic). These metal-based composite materials or intermetallic compound-based composite materials are lightweight and have a high strength and, therefore, find wide applications in space, aviation and other fields.

Paragraph [0004] has been amended as follows:

[0004] Generally, an intermetallic compound-based composite material has characteristic features that it is superior in ~~the~~ thermal characteristics, and ~~the~~ abrasive resistance characteristics derived from the mechanical and physical characteristics of the matrix.~~,~~ ~~while it has~~Typically, intermetallic compound-based composites have a defect ~~that it is~~of being inferior in ~~the~~ fracture toughness compared with a metal-based composite material. Furthermore, ~~it also has features that it shows~~intermetallic compound-based composites have a lower coefficient of thermal expansion and a high stiffness.

Paragraph [0005] has been amended as follows:

[0005] For producing an intermetallic compound-based composite material, ~~there can be mentioned~~there has been known a process which ~~comprises~~includes first producing an intermetallic compound powder by mechanical alloying or the like and subjecting the intermetallic compound and a reinforcing material (e.g. a fiber and/or particles), to hot

press (HP) or hot isostatic press (HIP) under high-temperature and high-pressure conditions. Also for producing a metal-based composite material, there can be mentioned a process requiring a high pressure, such as impregnation under pressure, melt forging or the like.

Paragraph [0013] has been amended as follows:

[0013] According to the present invention there is provided a process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound, which includes~~comprises:~~ mixing a metal powder with a reinforcing material to obtain a mixed powder, and~~fulfilling~~ placing the thus obtained mixed powder into a vessel.~~,~~ ~~placing~~ Al is placed on an upper side of the mixed powder ~~fulfilled into~~in the vessel, and ~~impregnating~~ the mixed powder is impregnated with an Al melt to give rise to a spontaneous combustion reaction between the metal powder and the Al melt to convert the Al melt into an aluminide intermetallic compound.~~,~~ ~~wherein~~ ~~t~~The Al melt and the metal powder are used respectively in such amounts that a mass ratio of a remaining Al after the spontaneous reaction to the intermetallic compound-based composite material is within a range from 0:10 to 3:7.

Paragraph [0021] has been amended as follows:

[0021] The present invention is also directed to a process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound.~~:~~ ~~said~~ The process ~~comprising;~~includes

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Amended specification paragraphs

mixing a metal powder and an oxide powder reducible by Al with a reinforcing material to obtain a mixed powder, and placing the~~fulfilling~~ thus obtained mixed powder into a vessel.~~,~~ ~~placing~~ Al is placed on an upper side of the mixed powder ~~fulfilled into~~in the vessel, and ~~impregnating~~ the mixed powder is impregnated with an Al melt to give rise to a spontaneous combustion reaction between the metal powder and the Al melt to convert the Al melt into an aluminide intermetallic compound.~~,~~ ~~wherein~~ The Al, the metal powder and the oxide powder are used respectively in such amounts that a mass ratio of a remaining Al after the spontaneous combustion reaction to the intermetallic compound-based composite material is within a range from 0:10 to 3:7.

Paragraph [0022] has been amended as follows:

[0022] In this embodiment of the present invention, it is preferable to use Al, the metal powder and the oxide powder in such an amount that ~~any of~~the Al, the metal powder and the oxide powder does not remain after the spontaneous combustion reaction. It is preferable to adjust the volumetric fraction of the reinforcing material in the present intermetallic compound-based composite material is preferably 10 to 70%.

Paragraph [0026] has been amended as follows:

[0026] Firstly, the first embodiment of the present will be explained below. This embodiment of the present invention is directed to a process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound. In the present process, a metal powder is admixed in advance with a reinforcing material to form a mixed powder.~~;~~ ~~thus formed~~ The mixed powder is

~~fulfilled~~placed into a vessel having an appropriate shape, then Al is placed on an upper portion of ~~thus fulfilled~~the mixed powder, and ~~Al is~~ melted to make an Al melt, which ~~penetrated~~penetrates into gaps of the mixed powder that can be considered to be a porous body. ~~, thereby a~~A spontaneous combustion reaction starts to produce an aluminide intermetallic compound as a result of in-situ synthesis. That is, Al is converted into the aluminide intermetallic compound, and the thus formed compound forms a matrix, thereby an intended intermetallic compound-based composite material is produced.

Paragraph [0028] has been amended as follows:

[0028] It is not preferred to use a metal powder and Al in such amounts that the remaining Al after the reaction exceeds the value of 3:7 in terms of the mass ratio to the aluminide intermetallic compound. This is because the decrease in the attractiveness as a high stiff material due to the reduction in Young's modulus. Moreover, it is not preferable because the reduction in the mechanical strength is apt to occur at around the melting point of Al while the fracture toughness increases. It is preferable to use a metal powder and Al in such amounts that the remaining Al after reaction is within a range of from 0:10 to 2:8 in terms of the mass ratio to the aluminide intermetallic compound, in order to obtain an intermetallic compound-based composite material having well-balanced fracture toughness and mechanical strength.

The paragraph on page 11, line 16 has been amended as follows:

~~[0033]~~ The present process differs from the methods disclosed in the JP-B-2,609,376 and JP-A-9-227969 in that only the matrix portion is formed in situ, in the case of the present

process. Therefore, one may not only freely choose reinforcing material, but also produce any composite material having desirable properties with designing the properties to be produced. Furthermore, one may control easily the heat of reaction at a predetermined level, by choosing arbitrarily the kinds and the amounts of the reinforcing materials according to the designed properties. Thus, the present process may be applicable in an industrial scale.

Paragraph [0037] has been amended as follows:

[0037] It is preferable to use Al and a metal powder in such proportions that Al does not substantially remain in the matrix of the resulting intermetallic compound-based composite material, in the case of the process for producing an intermetallic compound-based composite material according to the present invention, thereby one may obtain an intermetallic compound-based composite material which does not show such a phenomenon that the mechanical strength is reduced at around the melting point of Al or the like. Accordingly, the resultant product shows an excellent thermal resistance under flexural strength test at a higher temperature of 400°C which is described later without showing the reduction in the strength, like an intermetallic compound-based composite material in whose matrix Al remains. On the other hand, when Al is left in the matrix, one may obtain an intermetallic compound-based composite material having an increased fracture toughness because the brittle feature of the intermetallic compound-based composite material, which is well-known as one of drawbacks thereof, is improved by the remaining Al acting as a ductile phase therein.~~, when Al is left in the matrix.~~ The thermal resistance is lowered, as is discussed previously, though. Therefore, an intermetallic

compound-based composite material having superior characteristics such as mechanical strength and the like can be produced by compounding Al into a metal powder within the ratios mentioned previously.

Paragraph [0042] has been amended as follows:

[0042] An Al material used in carrying out this embodiment of the present process is not restricted to pure Al and an Al alloy may of course be used to obtain the same effect. Further, since the present process can produce an intermetallic compound-based composite material at temperatures lower than the melting point of the formed intermetallic compound, the reaction and/or fusion bonding of the composite material with the vessel to be ~~fulfilled~~filled with a mixed powder, the jig or product mold used takes place hardly. Therefore, the releasability of the produced composite material is very good and the present process can be suitably used also for production of an intermetallic compound-based composite material having a complicated shape.

Paragraph [0044] has been amended as follows:

[0044] The second embodiment of the present invention will be described in detail hereinbelow. This second embodiment is also directed to a process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound, like the first embodiment. This process comprises mixing a metal powder and an oxide powder reducible by Al with a reinforcing material to obtain a mixed powder.~~,~~ ~~fulfilling~~ The thus obtained mixed powder is placed into a vessel, ~~placing~~and Al is put on an upper side of the mixed powder in~~fulfilled into~~ the vessel.~~,~~ ~~and~~

~~impregnating~~ ~~t~~The mixed powder is impregnated with an Al melt to give rise to a spontaneous combustion reaction between the metal powder and the Al melt to convert the Al melt in situ into an aluminide intermetallic compound. In this case, Al is converted into a desired aluminide intermetallic compound to form the matrix ~~the~~ metal. There is in this embodiment no necessity of forming an intermetallic compound in advance, like the process of the first embodiment of the present process wherein only a metal powder is mixed with a reinforcing material. Thus, the number of the steps in the production process and the production cost can be reduced.

Paragraph [0045] has been amended as follows:

[0045] An oxide powder is reduced to a metal at the time when Al is melted and impregnated into ~~a~~the mixed powder in ~~a~~the vessel. Thus formed metal reacts with Al to form an aluminide intermetallic compound as a matrix. Al that reduced the oxide is converted into alumina, and dispersed within the matrix. Therefore, it becomes possible to produce with great easiness a composite material containing the reinforcing material in a high volumetric ratio, according to this embodiment. The following reaction scheme (4) is given to show an example of such a reaction:

$$3\ TiO_2 + 13\ Al \rightarrow 2\ Al_2O_3 + 3\ Al_3Ti \text{ ---- } (4).$$

Paragraph [0057] has been amended as follows:

[0057] A mixed powder of a reinforcing material and a metal powder is ~~fulfilled~~filled into a vessel having an appropriate shape, then the ~~fulfilled~~filled mixed powder is compacted under a pressure of about 1 MPa to obtain a compact; Al (commercial pure Al) is placed

on thus obtained compact. A usable Al is not limited to pure Al alone and may be any Al having a purity of about 90% or more. An Al alloy may also be used. Subsequently, the compact having Al thereon is heated to a temperature being several ten °C higher than the melting point of Al, for example, about 700°C under reduced pressure, for example, vacuum, so as to make molten Al impregnate into the micro-spaces between the starting materials in the compact. The penetration of the molten Al is immediately achieved by virtue of capillary action induced by the spontaneous combustion reaction, thereby a desired intermetallic compound-based composite material is formed.

Paragraph [0062] has been amended as follows:

[0062] As shown in Table 3, there were prepared, as reinforcing materials, Al_2O_3, AlN, SiC and Si_3N_4 all being ground particles having an average particle diameter of 47 to 54 μm; as metal powders, Ti, Ni and Nb all having an average particle diameter of 10 to 125 μm; and Al to be impregnated into the compacted mixed powder [commercial pure Al (A1050, purity: >99.5%)]. Next, Al and the respective metal powders were weighed in proportions capable of giving an aluminide intermetallic compound having a composition shown in Table 2. The metal powder and the reinforcing material were mixed so that the volume proportion of the reinforcing material became as shown in Table 3, to obtain a mixed powder. Each of thus prepared mixed powder was ~~fulfilled~~filled into a vessel; each of the ~~fulfilled~~filled mixed powder was compacted under a pressure of about 1 MPa; Al was placed on the compacted mixed powder. Each of the compacted mixed powder having Al thereon was kept under vacuum for a while, then heated to 700°C at the same

pressure, kept for about 1 hour at the same temperature, and cooled slowly to produce intermetallic compound-based composite materials (sample Nos. 1 to 11) shown in Table 3.

Please replace paragraph [0003] with the following rewritten paragraph:

a5

[0003] Among composite materials, metal-based composite materials or intermetallic compound-based composite materials are composite materials obtained by reinforcing a matrix, i.e. a metal (e.g. Al, Ti, Ni or Nb) or an intermetallic compound (e.g. TiAl, Ti_3Al, Al_3Ti, NiAl, Ni_3Al, Ni_2Al_3, Al_3Ni, Nb_3Al, Nb_2Al or Al_3Nb), with an inorganic material (e.g. a ceramic). These metal-based composite materials or intermetallic compound-based composite materials are lightweight and have a high strength and, therefore, find wide applications in space, aviation and other fields.

Please replace paragraph [0004] with the following rewritten paragraph:

a6

[0004] Generally, an intermetallic compound-based composite material has characteristic features that it is superior in thermal characteristics, andabrasive resistance characteristics derived from the mechanical and physical characteristics of the matrix. Typically, intermetallic compound-based composites have a defect of being inferior in fracture toughness compared with a metal-based composite material. Furthermore, intermetallic compound-based composites have a lower coefficient of thermal expansion and a high stiffness.

Please replace paragraph [0005] with the following rewritten paragraph:

a7

[0005] For producing an intermetallic compound-based composite material, there has been known a process which includes first producing an intermetallic compound powder by mechanical alloying or the like and subjecting the intermetallic compound and a reinforcing material (e.g. a fiber and/or particles), to hot press (HP) or hot isostatic press

a7 Contd.

(HIP) under high-temperature and high-pressure conditions. Also for producing a metal-based composite material, there can be mentioned a process requiring a high pressure, such as impregnation under pressure, melt forging or the like.

Please replace paragraph [0013] with the following rewritten paragraph:

a8

[0013] According to the present invention there is provided a process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound, which includes mixing a metal powder with a reinforcing material to obtain a mixed powder, and placing the thus obtained mixed powder into a vessel. Al is placed on an upper side of the mixed powder in the vessel, and the mixed powder is impregnated with an Al melt to give rise to a spontaneous combustion reaction between the metal powder and the Al melt to convert the Al melt into an aluminide intermetallic compound. The Al melt and the metal powder are used respectively in such amounts that a mass ratio of a remaining Al after the spontaneous reaction to the intermetallic compound-based composite material is within a range from 0:10 to 3:7.

Please replace paragraph [0021] with the following rewritten paragraph:

a9

[0021] The present invention is also directed to a process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound. The process includes mixing a metal powder and an oxide powder reducible by Al with a reinforcing material to obtain a mixed powder, and placing the thus obtained mixed powder into a vessel. Al is placed on an upper side of the mixed powder in the vessel, and the mixed powder is impregnated with an Al melt to give rise to

a9 Contd.

a spontaneous combustion reaction between the metal powder and the Al melt to convert the Al melt into an aluminide intermetallic compound. The Al, the metal powder and the oxide powder are used respectively in such amounts that a mass ratio of a remaining Al after the spontaneous combustion reaction to the intermetallic compound-based composite material is within a range from 0:10 to 3:7.

Please replace paragraph [0022] with the following rewritten paragraph:

a10

[0022] In this embodiment of the present invention, it is preferable to use Al, the metal powder and the oxide powder in such an amount that the Al, the metal powder and the oxide powder does not remain after the spontaneous combustion reaction. It is preferable to adjust the volumetric fraction of the reinforcing material in the present intermetallic compound-based composite material is preferably 10 to 70%.

Please replace paragraph [0026] with the following rewritten paragraph:

a11

[0026] Firstly, the first embodiment of the present will be explained below. This embodiment of the present invention is directed to a process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound. In the present process, a metal powder is admixed in advance with a reinforcing material to form a mixed powder. The mixed powder is placed into a vessel having an appropriate shape, then Al is placed on an upper portion of the mixed powder, and melted to make an Al melt, which penetrates into gaps of the mixed powder that can be considered to be a porous body. A spontaneous combustion reaction starts to produce an aluminide intermetallic compound as a result of in-situ synthesis. That is, Al is

A11 Cont'd.

converted into the aluminide intermetallic compound, and the thus formed compound forms a matrix, thereby an intended intermetallic compound-based composite material is produced.

Pleas replace paragraph [0028] with the following rewritten paragraph:

A12

[0028] It is not preferred to use a metal powder and Al in such amounts that the remaining Al after the reaction exceeds the value of 3:7 in terms of the mass ratio to the aluminide intermetallic compound. This is because the decrease in the attractiveness as a high stiff material due to the reduction in Young's modulus. Moreover, it is not preferable because the reduction in the mechanical strength is apt to occur at around the melting point of Al while the fracture toughness increases. It is preferable to use a metal powder and Al in such amounts that the remaining Al after reaction is within a range of from 0:10 to 2:8 in terms of the mass ratio to the aluminide intermetallic compound, in order to obtain an intermetallic compound-based composite material having well-balanced fracture toughness and mechanical strength.

Please replace the paragraph on page 11, line 16 with the following rewritten paragraph:

A13

The present process differs from the methods disclosed in the JP-B-2,609,376 and JP-A-9-227969 in that only the matrix portion is formed in situ, in the case of the present process. Therefore, one may not only freely choose reinforcing material, but also produce any composite material having desirable properties with designing the properties to be produced. Furthermore, one may control easily the heat of reaction at a predetermined

A13 Contd.

level, by choosing arbitrarily the kinds and the amounts of the reinforcing materials according to the designed properties. Thus, the present process may be applicable in an industrial scale.

Please replace paragraph [0037] with the following rewritten paragraph:

A14

[0037] It is preferable to use Al and a metal powder in such proportions that Al does not substantially remain in the matrix of the resulting intermetallic compound-based composite material, in the case of the process for producing an intermetallic compound-based composite material according to the present invention, thereby one may obtain an intermetallic compound-based composite material which does not show such a phenomenon that the mechanical strength is reduced at around the melting point of Al or the like. Accordingly, the resultant product shows an excellent thermal resistance under flexural strength test at a higher temperature of 400°C which is described later without showing the reduction in the strength, like an intermetallic compound-based composite material in whose matrix Al remains. On the other hand, when Al is left in the matrix, one may obtain an intermetallic compound-based composite material having an increased fracture toughness because the brittle feature of the intermetallic compound-based composite material, which is well-known as one of drawbacks thereof, is improved by the remaining Al acting as a ductile phase therein. The thermal resistance is lowered, as is discussed previously, though. Therefore, an intermetallic compound-based composite material having superior characteristics such as mechanical strength and the like can be produced by compounding Al into a metal powder within the ratios mentioned previously.

Substitute specification paragraphs

a15

Please replace paragraph [0042] with the following rewritten paragraph:

[0042] An Al material used in carrying out this embodiment of the present process is not restricted to pure Al and an Al alloy may of course be used to obtain the same effect. Further, since the present process can produce an intermetallic compound-based composite material at temperatures lower than the melting point of the formed intermetallic compound, the reaction and/or fusion bonding of the composite material with the vessel to be filled with a mixed powder, the jig or product mold used takes place hardly. Therefore, the releasability of the produced composite material is very good and the present process can be suitably used also for production of an intermetallic compound-based composite material having a complicated shape.

a16

Please replace paragraph [0044] with the following rewritten paragraph:

[0044] The second embodiment of the present invention will be described in detail hereinbelow. This second embodiment is also directed to a process for producing an intermetallic compound-based composite material comprising a reinforcing material and an intermetallic compound, like the first embodiment. This process comprises mixing a metal powder and an oxide powder reducible by Al with a reinforcing material to obtain a mixed powder. The thus obtained mixed powder is placed into a vessel, and Al is put on an upper side of the mixed powder in the vessel. The mixed powder is impregnated with an Al melt to give rise to a spontaneous combustion reaction between the metal powder and the Al melt to convert the Al melt in situ into an aluminide intermetallic compound. In this case, Al is converted into a desired aluminide intermetallic compound to form the matrix metal. There is in this embodiment no necessity of forming an intermetallic

a18 cont'd

The penetration of the molten Al is immediately achieved by virtue of capillary action induced by the spontaneous combustion reaction, thereby a desired intermetallic compound-based composite material is formed.

Please replace paragraph [0062] with the following rewritten paragraph:

a19

[0062] As shown in Table 3, there were prepared, as reinforcing materials, Al_2O_3, AlN, SiC and Si_3N_4 all being ground particles having an average particle diameter of 47 to 54 μm; as metal powders, Ti, Ni and Nb all having an average particle diameter of 10 to 125 μm; and Al to be impregnated into the compacted mixed powder [commercial pure Al (A1050, purity: >99.5%)]. Next, Al and the respective metal powders were weighed in proportions capable of giving an aluminide intermetallic compound having a composition shown in Table 2. The metal powder and the reinforcing material were mixed so that the volume proportion of the reinforcing material became as shown in Table 3, to obtain a mixed powder. Each of thus prepared mixed powder was filled into a vessel; each of the filled mixed powder was compacted under a pressure of about 1 MPa; Al was placed on the compacted mixed powder. Each of the compacted mixed powder having Al thereon was kept under vacuum for a while, then heated to 700°C at the same pressure, kept for about 1 hour at the same temperature, and cooled slowly to produce intermetallic compound-based composite materials (sample Nos. 1 to 11) shown in Table 3.

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